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2001

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GUIDELINE FOR THE INSTALLATION AND OPERATION OF CONTINUOUS EMISSION MONITORING SYSTEMS (CEMS) AND THEIR USE FOR REPORTING UNDER THE PROVISIONS OF

REGULATION O.Reg. 127/01

Ontario Ministry of the Environment

April, 2001

Ontario

GUIDELINE FOR THE INSTALLATION AND OPERATION OF CONTINUOUS EMISSION MONITORING SYSTEMS (CEMS) AND THEIR USE FOR REPORTING UNDER THE PROVISIONS OF REGULATION O.Reg. 127/01

1. INTRODUCTION

This Guideline is issued for the purpose of providing guidance in respect to the selection, installation, commissioning and operation of continuous emission monitors required by the provisions of Regulation O.Reg. 127/01.

All the matters addressed in this document are general in nature and the recommendations given herein should not be construed as providing specific directions for any particular CEM system. Each installation is site specific. No particular brands of equipment are endorsed.

This document may be reviewed and modified periodically as warranted by modifications to Regulation O.Reg. 127/01 or developments in the field of continuous emission monitoring.

2. DEFINITIONS

In this Guideline,

"continuous emission monitoring system" means the equipment and programs required to analyze one or several specific compounds in the gaseous effluent emissions of a discharge unit, quantify the amount of specific compounds emitted per unit time, and process the information for reporting these emissions in the manner prescribed by Regulation O.Reg. 127/01.

"Director" means the Director of the Environmental Monitoring and Reporting Branch of the Ministry of the Environment;

"discharge unit" means a device, or a group of devices that operate together in such a manner that one device cannot function independently of the other devices in the unit, and that discharges or has the potential to discharge a contaminant into the air;

"discharger" means an owner or person in occupation, or having the charge, management or control of a facility to which this Regulation applies;

"energy intensity rate" means the total energy output of an electricity generation unit or the total energy input into any other kind of discharge unit;

"facility" includes all buildings, equipment, structures and stationary items, such as surfaces and storage piles, that,

(a) are located on a single site, or

(b) are located on two or more contiguous or adjacent sites that are owned or operated by the same person and function as a single integrated site;

"location" means the geo-reference coordinates including elevation above sea level (to the metre);

"predictive emission monitoring system (PEM)" means any system able to predict the concentration and emission rate of a contaminant based on correlation(s) with other monitored parameters;

"smog period" means the period from May 1 to September 30;

3. APPLICATION

The recommendations of this Guideline apply only with respect to facilities of a source sector listed in Table 1 to the *Step by Step Guideline for Emission Calculation, Record Keeping and Reporting for Airborne Contaminant Discharge* as a Class A Source Sector Facility, Class B Source Sector Facility or Class C Source Sector Facility, which are covered by the provisions of Section 3 (4) of the *Airborne Contaminant Discharge - Monitoring and Reporting Regulation* (Regulation O.Reg. 127/01).

Such facilities are expected to be either thermal electricity generation units, or discharge units of other industrial processes, with a total design energy input larger than 73 MW each. For clarifications on the relationship between emission rates calculated based on energy input, energy output, and flue gas concentration, please refer to Appendix A of this Guideline.

A facility is exempt from the installation and operation of a CEM for emission reporting purposes if the total annual emissions of a respective contaminant are less than the reporting threshold listed in Table 2A to the *Step by Step Guideline for Emission Calculation, Record Keeping and Reporting for Airborne Contaminant Discharge.*

The CEMs covered by the recommendations of this Guideline are those for sulphur oxides (SO_x) and nitrogen oxides (NO_x) but, insofar as the Director may require or authorize CEMs for other pollutants to be installed, operated, and used for reporting emissions pursuant to the provisions of Regulation O.Reg. 127/01, such other CEMs are also covered.

SO_x shall be measured and reported as SO_2.

NO_x shall be measured and reported as the total of NO and NO_2. If a discharger can show, based on acceptable source testing, that a discharge unit emits NO_2 at rates of less than 5% of the rate

of emission of NO, that discharger may propose, and the Director may approve, that reporting of NO_x is based on continuous emission monitoring of NO and the addition of the NO_2 fraction based on the percentage factor determined during source testing.

4. NOTIFICATION

A discharger affected by the reporting provisions of Regulation O.Reg. 127/01, and who elects, or is required by the Director to monitor and report emissions using a CEM system shall notify the Director of the selection of a CEM system, the successful commissioning of the said CEM system, and the preparation of a Quality Assurance and Quality Control Plan for the CEM System. Each CEM system shall have its own Quality Assurance and Quality Control Plan.

The discharger shall notify the Director as soon as possible if any changes are made to any part of a CEM system, including its Quality Assurance and Quality Control Plan.

The discharger shall notify the Director of the findings of the annual audits required under Section 5.4 of this Guideline.

5. CEM SYSTEMS

5.1 General

All CEMs systems shall be designed, installed, and operated following the recommendations of the document titled *Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation - Report EPS 1/PG/7* (hereinafter called 1/PG/7) published by Environment Canada in September 1993, or as modified.

Where several units discharge to atmosphere through a single stack, a single CEM system may be installed on that stack provided that by the use of relevant operating parameters the unit specific emissions can be apportioned respectively. Where a discharge unit emits to the atmosphere through more than one stack, an individual CEM system must be used at each such stack.

Time sharing of analyzers (i.e. cycling between analyzers located at various stacks and connected to a single data acquisition system) is allowed within the specific constraints of Section 3.3 of 1/PG/7.

Dischargers may also propose, and the Director may approve, the use of Predictive Emission Monitoring (PEM) systems for reporting emissions under the provisions of Regulation O.Reg. 127/01.

5.2 CEM System Parts

A CEM system shall comprise:

- Instrumentation and programs that will determine, analyze, and quantify the concentration of the specified contaminant(s) in the gas stream;

- Instrumentation and/or programs that will determine the flow rate of the gas stream carrying the contaminant(s);

- Instrumentation and programs that will record and process the information produced by the above noted instruments and programs and produce electronic and printed reports showing the emission rate of specified contaminants with the time resolution specified in Regulation O.Reg. 127/01 and as detailed below.

- Quality assurance programs and procedures to ensure that all contaminant measurements, instrument verifications, and reporting activities are performed adequately.

Notwithstanding all of the above, the Director may allow the discharger that was required to report using a CEM system, to report using any alternate PEM system that is proven able to produce, and produces, contaminant-specific emission rates with an accuracy verifiably equal with that of a CEM system. Such PEM systems may, for example, produce reports based on information supplied by CEM systems.

5.3 Instrument Specifications

Each gas analyzer shall be proven to be able to meet the design specifications given in Table 1 of 1/PG/7 on the basis of manufacturers specifications and guarantees and successful completion of field certification in accordance with the provisions of section 5.3 of 1/PG/7.

The discharger shall submit to the Director a detailed description of the proposed CEM system, which shall include all instrument design specifications.

A discharger that was required to report using a CEM system, may only use for reporting alternate PEM systems that are proven to meet equivalent design specifications based on the design specifications of the underlying instrumentation whose readings are correlated with the emission numbers produced.

5.4 CEM System Operation

All components of the CEM systems shall be maintained and operated at all times at performance levels equal to those specified in Table 3 of 1/PG/7.

The performance of a CEM system shall be documented through audits performed annually by an independent third party in accordance with the provisions of the previously established site-specific Quality Assurance/Quality Control Manual.

Alternate PEM systems deemed equivalent to CEM systems shall be proven to meet performance specifications equivalent to those specified in Table 3 of 1/PG/7 based on the performance levels of the underlying instrumentation whose readings are correlated with the emission numbers produced. Such PEM systems could be used, for example, to provide backfilling data for the periods when emission data are missing due to a malfunction of the CEM systems.

PEM systems may not be used for reporting purposes for a period longer than 168 hours without being able to prove, to the satisfaction of the Director, that the data are valid, on the basis of another CEM system or source testing using an approved Reference Method.

The Director shall be notified of any CEM system malfunction lasting longer than seven consecutive days.

The discharger shall immediately inform the Director of any changes in the reporting procedures based on changes to a CEM system.

6. REPORTING

Reports produced by a CEM system shall be submitted no later than 60 days after the end of each quarter. The reports shall be in electronic format (to be supplied by the Director) and in hard copy on a printed form. The reports shall also contain the following information:

- The name and address of the discharger or the person who prepared the report on behalf of the discharger;

- The name, address and geographical location (i.e. coordinates and designation on the municipal plan) of the facility;

- The name or number of the discharge unit (generation unit in the electricity generation sector) or stack to which the continuous emission monitoring system applies;

- The type of discharge unit (generation unit in the electricity generation sector), e.g.: boiler (describe type of boiler), combustion turbine (describe type of combustion turbine), reciprocating engine, furnace, process heater, reactor, incinerator, or other (describe);

- The type or types of energy sources used by the discharge unit (generation unit in the electricity generation sector) to produce its product (electricity in the electricity generation

sector): i.e. fuel (e.g.: coal, oil, gas, diesel, refuse, wood), process material inputs (specify), other (specify);

- The type of pollution control device or method used by the discharge unit (generation unit in the electricity generation sector) to control emissions of each contaminant from the discharge unit measured by the CEM system during the quarter (there should be separate entries for each contaminant controlled);

- The amount of each contaminant, in tonnes, emitted from the discharge unit (generation unit in the electricity generation sector) and measured by the CEM system, discharged monthly, quarterly, and cumulatively year-to-date and cumulatively smog-season-to-date;

- The monthly, quarterly, cumulative year-to-date, and cumulative smog-season-to-date, average emission rate for each contaminant emitted from the electricity generation unit and measured by the CEM system. The average emission rate shall be expressed in kg/MWh and shall be calculated based on the electric energy output.

Information that does not change from one report to the next, e.g.: address, location, etc., can be omitted from reports subsequent to the first one.

The discharger shall also monitor, record, and make available upon request the following:

- A plot plan showing the location of the discharge unit (generation unit in the electricity generation sector), any stack through which the contaminant is discharged from the discharge unit, and every pollution control device that is intended to reduce emissions of the contaminant from the discharge unit;

- The average hourly concentration of each contaminant subject to Regulation O.Reg. 127/01, and the average hourly flow rate and temperature of the gas carrying the contaminant for each discharge unit monitored by a CEM system;

- The monthly, quarterly, cumulative year-to-date, and cumulative smog-season-to-date, energy-intensity-rate expressed as MWh electricity produced, for discharge units monitored by CEM systems in the electricity sector, and total MWh energy input, for discharge units monitored by CEM systems in the other sectors;

- The monthly, quarterly, cumulative year-to-date, and cumulative smog-season-to-date, average emission rate for each contaminant emitted from the discharge unit, and measured by the CEM system - this applies to discharge units in sectors other than electricity generation. The average emission rate shall be expressed in kg/MWh and shall be calculated based on the total energy input;

- The number of hours that the discharge unit (generation unit in the electricity generation sector) monitored by the CEM system operated during each month;

- The hourly average fuel caloric value and rate of consumption for any combustion unit monitored by a CEM system;

- The date and results of the last quarterly performance evaluation, including CEM system availability, performed in accordance with the provisions of Section 6.2 of 1/PG/7;

- The date and results of the last semi-annual performance evaluation, including CEM system availability, performed in accordance with the provisions of Section 6.3 of 1/PG/7;

- The date and results of the last annual evaluation, including CEM system availability, performed in accordance with the provisions of Section 6.4 of 1/PG/7;

- All other information and backup data used in the calculation of the above-mentioned numbers.

The discharger shall ensure that all the information and data used in calculating any of the numbers included in the reports prepared in accordance with the provisions of this guideline, including all the reports, are kept for at least seven years after they are made and that the records are made available to a Provincial Officer of the Ministry on request made in advance.

APPENDIX A

Relationships Between Emission Rates Calculated in Various Units

The relationship between standards based on the mass (m) of pollutant emitted per unit of energy input (E_{in}) and electricity (or energy) output (E_{out}) is based on the conversion yield. For typical fossil fired power plants the yield $\eta \approx 32\%$. Therefore:

$Std_{in} = m/E_{in}$ $\quad Std_{out} = m/E_{out}$ $\quad E_{out}/E_{in} = \eta$ $\quad \Rightarrow Std_{out} = Std_{in}/\eta$

Example:

$Std_{out} = 1.6$ lb/MWh = 725.75 g/MWh

$Std_{in} = 0.15$ lb/MMBTU = 232.37 g/MWh

$\Rightarrow Std_{out} = Std_{in}/0.32$

For combustion sources, standards based on energy input and standards based on the concentration of the flue gas are related to one another based on the F factors. The F factor is the theoretical minimum volume of flue gas (at standard conditions) generated after complete combustion of a given fuel per unit heat input. In general:

$Std_{conc.} = Std_{energy}/F$ where Std_{energy} is the standard based on fuel heat input.

Example:

For a hypothetical coal fired unit for which $F=0.27 m^3/MMJ$, an energy input based standard:

$Std_{energy} = 0.15$ lb/MMBTU is equivalent to an outlet concentration standard:

$Std_{conc.} = [(0.15 lb/MMBTU * 453.5944 * 10^3 mg/lb)/1055 MMJ/MMBTU]/[0.27 m^3/MMJ] =$
$= 239 mg/m^3$

The conversion values used in this calculation are:

1 lb = 453.5944 g
1 W = 1 J/s
1 BTU = 1055 J

In reality, combustion does not take place at minimum volume and corrections are applied to F factors to take into account the amount of excess air and humidity. The use of various F factor corrections for such situations is described in detail in the Appendix A of 1/PG/7.